



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/605,645	10/15/2003	Manojkumar Saranathan	GEMS8081.176	2644
27061 7590 05/16/2008 ZIOLKOWSKI PATENT SOLUTIONS GROUP, SC (GEMS) 136 S WISCONSIN ST PORT WASHINGTON, WI 53074			EXAMINER ABRAHAM, SALIEU M	
			ART UNIT 3768	PAPER NUMBER
			NOTIFICATION DATE 05/16/2008	DELIVERY MODE ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

info@zpspatents.com
rlt@zpspatents.com
klb@zpspatents.com

Office Action Summary	Application No.	Applicant(s)	
	10/605,645	SARANATHAN ET AL.	
	Examiner	Art Unit	
	SALIEU M. ABRAHAM	3768	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 December 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4-14 and 16-25 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2,4-14,16-25 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Remarks/Arguments

1. Applicant's arguments filed December 21, 2007 have been fully considered, but are not persuasive.
2. Examiner acknowledges all claim amendments and cancellations and withdraws the claim objection to claim 21 and the **35 USC § 101** rejection to claim 25.
3. At the crux of applicant's argument is the Mulger III reference and whether or not it teaches or suggest using **dummy acquisitions**. Specifically, applicant correctly restates the characteristics of the MP period (e.g. type of applied pulses and/or delays) and, furthermore, asserts that
"nowhere does Mulger III **explicitly** teach or suggest playing out a dummy acquisition following each of the magnetic preparation pulses. Therefore, Ookawa in view of Laub, or any combination therefrom incorporating previously cited references, cannot be said to teach or suggest the step of playing out a dummy acquisition following each of the magnetic preparation pulses." Finally, the benefit of applying dummy acquisitions/pulses over the state of the art is cited.
4. Examiner wishes to acknowledge applicant's arguments and reiterate being aware of the benefit of the dummy acquisition (see page 6, item 1, last sentence of prior 9/26/07 action). However, Examiner respectfully disagrees with Applicant's assertion that the Mulger III reference does not suggest "the step of playing out a dummy acquisition

following each of the magnetic preparation pulses.” Mulger III does suggest that incorporation of a delay period before **actual/real data acquisitions** is advantageous to improving image quality, particularly in the form of contrast, and this has been acknowledged by applicant (see page 7 of 12/21/07 arguments) as well. Further, this approach of delay incorporation before actual data acquisition is commonly known in the art to employ dummy acquisitions in the implementation. Therefore, one of ordinary skill in the art would find it obvious to employ a dummy acquisition delay means in order to improve image quality.

5. Further, examiner has applied the art of record by Jezzard in place of Mulger III in the instant action in order to further address the dummy acquisition limitation in the claims. Jezzard expressly discloses the use of dummy acquisitions as delay means that achieve the exact image quality (e.g. image quality improvement via ghosting reduction associated with steady state effects) results cited by applicant. The same basis of applying a delay means before actual data acquisition is maintained.

6. As a result, no new grounds of rejection have been made in the instant action, all rejections are only modified to address the claims as amended, and this action is

FINAL.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 1,2, 4 through 6, 9, 10 and 20 - 25 are rejected under 35 U.S.C. 102(b) as being unpatentable over Pub. No. US 2001/0004211 to Ookawa (Ookawa) in view of US Pat. No. 6,380,740 to Laub (Laub) further in view of Jezard, Peter "Physical Basis of Spatial Distortions in Magnetic Resonance Images." in: Bankman, Isaac N., Handbook of Medical Imaging Processing and Analysis (San Diego, Academic Press, 2000), pp. 425-435; hereinafter Jezard (Jezard).

In Reference to Claim 1

Ookawa teaches:

A method of MR imaging comprising the steps of:

partitioning k-space into a number of partitions (see fig. 6 and section [0027] on page 2),

wherein the partitions incrementally increase in distance from a center of k-space (see fig. 6 and section [0031] on page 2);

Ookawa also explicitly teaches:

applying magnetic preparation pulses (flip pulse) and acquiring data such that a rate by which the magnetic preparation pulses are applied is a function of the incremental distance a partition of MR data is from the center of k-space (see fig. 5 and section [0031] on page 2). However Ookawa fails to explicitly teach "applying magnetic preparation pulses and acquiring data ***in an elliptic centric acquisition order***, such that a rate by which the magnetic preparation pulses are applied is a function of the incremental distance a partition of MR data is from the center of k-space." Ookawa does disclose a 3D sampling and acquisition scheme that can be used for MR Angiography (MRA) and involves interrogating a "plurality of (annular) regions" (see fig. 6 and sections [0027] and [0031] on page 2) demarcated in "elliptic centric" fashion.

Laub discloses using 3D fast gradient pulse sequences in dynamic MRA studies for improving "spatial/temporal resolution " which employ elliptic centric acquisition order (see abstract, column 3, lines 23-64 and figures 6-9).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have included the elliptic centric data acquisition order of Laub in the method of Ookawa to further improve image spatial and temporal resolution as explicitly taught Laub.

However, Ookawa in view of Laub does not disclose “and playing out a dummy acquisition following each of the magnetic preparation pulses.”

Jezzard, in the same field of endeavor, teaches the application of a delay which is determined by applying dummy acquisitions or scans in order to allow spins to have reached a steady state when the image signal is detected and to curtail non-frequency-encoded (e.g. phase- and/or slice-encode) derived artifact or noise ; (see **Jezzard, p. 434, section 6.2 “Non-Steady State Effects”, and equations 11, 12 and 13**). Further, it has been discussed that it is well known in the art to apply dummy acquisitions prior to actual data acquisition and after magnetization preparation . (see **items 4 and 5 in Remarks supra**)

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have included the dummy acquisitions or scans of Jezzard in the method of Ookawa in view of Laub to allow steady state spin conditions to be achieved and reduce the corresponding image noise effects as explicitly taught Jezzard.

In Reference to Claim 2

Ookawa in view of Laub further in view of Jezzard has been shown to teach all of the limitations of claim 1. In addition Ookawa further teaches:

The method of claim 1 wherein the magnetic preparation pulses are saturation pulses

(e.g. pre-saturation pulse in Ookawa; see page 2, section [0021]), and further comprising the step of decreasing the rate by which the saturation pulses are applied as the distance a partition of MR data is from the center of k-space increases (see fig. 6 and sections [0027] – [0031] on page 2, and sections [0032] and [0033] page 3).

Therefore, Ookawa in view of Laub further in view of Jezzard teaches all claim 2 limitations.

In Reference to Claim 4

The claim states: “The method of claim 1 further comprising the step of playing out the magnetic preparation pulses every $N_i TR$ for an i th partition, wherein $N_1 < N_2 < N_{M-1} < N_M$, and M corresponds to the number of partitions.”

Ookawa in view of Laub further in view of Jezzard has been shown to teach all of the limitations of claim 1 as discussed above. Ookawa further teaches “the step of playing out the magnetic preparation pulses every $N_i TR$ for an i th partition, wherein $N_1 < N_2 < N_{M-1} < N_M$, and M corresponds to the number of partitions” (see abstract, figs. 5 and 6, sections [0027] – [0031] on page 2, and sections [0032] – [0036] on page 3).

Therefore, Ookawa in view of Laub further in view of Jezzard teaches all claim 4 limitations.

In Reference to Claim 5

Claim 5 states: "The method of claim 4 wherein the number of partitions includes three partitions for a given image acquisition, wherein N_i includes $N_1 < N_2$ and $N_2 < N_3$."

Ookawa in view of Laub further in view of Jezzard has been shown to teach all of the limitations claim 4. Ookawa further teaches that the number of (i.e. k-space) partitions (region divisions) may be "changed in various patterns" (see sections [0033] –[0036] on page 3) and "can be variously modified" to adjust the image contrast and the output of artifacts.

It would have been obvious to one of ordinary skill in the art at the time of the invention to have selected three partitions as taught to optimally vary the number of partitions in order to "adjust the image contrast and the output of artifacts" as explicitly taught in Ookawa.

Therefore, Ookawa in view of Laub further in view of Jezzard teaches all claim 5 limitations.

In Reference to Claim 6

Claim 6 states: "The method of claim 5 wherein the step of applying magnetic preparation pulses includes the step of playing out fat saturation pulses every

five TRs for the first partition, every 15 TRs for the second partition, and every 40 TRs for the third partition.”

Ookawa in view of Laub further in view of Jezzard has been shown to teach all of the limitations of claim 5. Ookawa further teaches that the rate or “frequency” at which (magnetization or) pre- pulses are played out may also be “changed in various patterns” (see sections [0034] –[0036] on page 3). Ookawa further teaches, “ various patterns can be adopted for the division method of regions using different frequencies in the k-space, i.e., for region boundaries. A plurality of region division pattern data in the k-space may be prepared and may be selectively used in accordance with an instruction from the operator. These frequency patterns and region division patterns can be arbitrarily combined and used to arbitrarily adjust the image contrast and the output of artifacts.” (see section [0035] on page 3)

It would have been obvious to one of ordinary skill in the art at the time of the invention to have selected the “step of playing out fat saturation pulses every five TRs for the first partition, every 15 TRs for the second partition, and every 40 TRs for the third partition” in order to “adjust the image contrast and the output of artifacts” for the particular application at hand as taught by Ookawa.

Therefore, Ookawa in view of Laub further in view of Jezzard teaches all claim 6 limitations.

In Reference to Claim 9

Claim 9 states: “The method of claim 1 wherein the magnetic preparation pulses are fat saturation pulses, and further comprising the step of maximizing fat saturation while minimizing differential weighting of k-space while acquiring the central of region k-space.”

Ookawa in view of Laub further in view of Jezard has been shown to teach all of the limitations of claim 1. Additionally, Ookawa has been shown to teach the step of optimizing fat saturation based on the particular application at hand (see section [0035] on page 3). However, Ookawa fails to teach “the step of maximizing fat saturation while minimizing differential weighting of k-space while acquiring the central of region k-space.”

It is well known in the art that dummy acquisitions as mentioned earlier may be used to address the issue of compensating for “differential weighting of k-space while acquiring the central of region k-space” that results from non-steady state sampling effects when a centric phase encoding technique is used. It is in order to maintain steady state and minimize noise effects, that these delays are employed for peripheral-central region-based sampling .

It would have been obvious to one of ordinary skill in the art that the step of “minimizing differential weighting of k-space while acquiring the central of region k-space” would apply for sampling schemes which employed elliptic centric order acquisitions and which incorporated dummy acquisitions when transitioning between a peripheral region to the central region.

Therefore, Ookawa in view of Laub further in view of Jezard teaches all claim 9 limitations.

In Reference to Claim 10

Ookawa in view of Laub further in view of Jezard has been shown to teach all of the limitations of claim 1. In addition Ookawa further teaches: The method of claim 1 wherein the data acquisition in k-space includes a radial acquisition in k-space (see figure 6). See also Laub column 3, lines 48-64.

Therefore, Ookawa in view of Laub further in view of Jezard teaches all claim 10 limitations.

In Reference to Claim 20

Ookawa in view of Laub teaches:

A computer readable storage medium having stored thereon a set of instructions that when executed by a computer (see Ookawa figure 1) causes the computer to:

- **partition** k-space data into a number of partitions (see Ookawa fig. 6 and section [0027] on page 2), each a given distance from a center of k-space (see Ookawa fig. 6 and section [0031] on page 2);
- **play out** a magnetic preparation pulse at a different rate for each partition, the rate being dependent on the given distance a partition is from the center of k-

space (see Ookawa fig. 5 and section [0031] on page 2);

- **acquire** MR data in an elliptical centric order (see Laub abstract, column 3, lines 23-64 and figures 6-9);

However, Ookawa in view of Laub does disclose:

A computer readable storage medium having stored thereon a set of instructions that when executed by a computer causes the computer to:

- **play out** at least one dummy acquisition during MR data acquisition following each of the magnetic preparation pulses.

The basis for applying dummy acquisitions after magnetic preparation pulses in order to effect delays and boost overall image quality has been discussed (**see claim 1 rejection**).

Therefore, Ookawa in view of Laub further in view of Jezard teaches all claim 20 limitations.

In Reference to Claim 21

Ookawa in view of Laub further in view of Jezard has been shown to teach all limitations of claim 20. In addition Ookawa further teaches: ... wherein each partition is centered about a center of k-space (see figure 6) such that magnetic preparation occurs more frequently during MR data acquisition of a partition closer to the center of k-space than that of a partition farther from the center of k-space (see figures 5 and 6, and

section [0033] on page 3).

Therefore, Ookawa in view of Laub further in view of Jezard teaches all claim 21 limitations.

In Reference to Claim 22

Claim 22 States: "The computer readable storage medium of claim 21 wherein a rate of magnetic preparation pulses is non-zero for each partition."

Ookawa in view of Laub further in view of Jezard has been shown to teach all the limitations of claim 21. In addition, Ookawa further discloses "wherein a rate of magnetic preparation pulses is non-zero for each partition" (see sections [0033] and [0034] on page 3).

Therefore, Ookawa in view of Laub further in view of Jezard teaches all claim 22 limitations.

In Reference to Claim 23

Claim 23 States: " The computer readable storage medium of claim 20 wherein the set of instructions further causes the computer to define boundaries of each partition and determine the number of partitions based on a k-space extent of a 3D image FOV."

Ookawa in view of Laub further in view of Jezard has been shown to teach all of the limitations of claim 20. Laub further teaches the step “wherein the set of instructions further causes the computer to define boundaries of each partition and determine the number of partitions based on a k-space extent of a 3D image FOV.” Laub teaches the partitioning of k-space into 3D annular partitions so as to improve spatial and or time resolution (see Laub figures 3,4 and 6, and column 3, lines 23-63). Laub further teaches that the selection of the number and relative size of the segments may be varied and customized to the application at hand so as to enable sufficient spatial and temporal resolution for tracking dynamic (fast) events within the body (see Laub, column 7, lines 13-21).

Therefore, Ookawa in view of Laub further in view of Jezard teaches all claim 23 limitations.

In Reference to Claim 24

Claim 24 States: ” The computer readable storage medium of claim 23 wherein the set of instructions further causes the computer to define the boundaries and the number of partitions such that k-space discontinuity between adjacent k-space views is reduced.”

Ookawa in view of Laub further in view of Jezard has been shown to teach all of the limitations of claim 23. Laub further teaches that the 3D annular segments

Art Unit: 3737

of his invention are bounded consecutively (respectively or one after the other) so that a central region is encompassed within a number of peripheral regions and that this approach improves spatial resolution over prior methods (see Laub figures 3,4 and 6, column 3, lines 28-63, column 7, lines 38-46). Also, the MR data is acquired using centric phase encoding. It is well known in the art that centric phase encode methods such as described by Laub employ techniques which minimize k-space discontinuities between adjacent k-space views.

Therefore, Ookawa in view of Laub further in view of Jezard teaches all claim 24 limitations.

In Reference to Claim 25

Ookawa in view of Laub further in view of Jezard has been shown to teach all of the limitations of claim 20. In addition Ookawa further teaches: The "computer readable storage medium of claim 20 wherein the rate for each partition is non-linearly dependent on the given distance a partition is from the center of k-space (see figure 5 and sections [0033] -[0034] on page 3).

The contributions of Laub and Jezard to Ookawa with regard to "wherein the set of instructions further causes the computer to play out a dummy acquisition following each magnetic preparation pulse and prior to data acquisition in each partition have been discussed above (see **claim 1 and 20 rejections**).

Therefore, Ookawa in view of Laub further in view of Jezard teaches all claim

25 limitations.

9. Claims 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pub. No. US 2001/0004211 A1 to Ookawa (Ookawa) in view of US Pat. No. 6,380,740 to Laub (Laub) further in view of Jezard, Peter "Physical Basis of Spatial Distortions in Magnetic Resonance Images." in: Bankman, Isaac N., Handbook of Medical Imaging Processing and Analysis (San Diego, Academic Press, 2000), pp. 425-435; hereinafter Jezard (Jezard), and further in view of Stephen J. Riederer (Riederer), "Current Technical Development in Magnetic Resonance Imaging", IEEE Engineering in Medicine and Biology Magazine, September/October 2000.

In Reference to Claim 7

Claim 7 states: "The method of claim 1 further comprising the step of determining the number of partitions based on an FOV from which MR data is to be acquired."

Ookawa in view of Laub further in view of Jezard has been shown to teach all of the limitations of claim 1. However, Ookawa in view of Laub further in view of Jezard does not explicitly teach "the step of determining the number of partitions based on an FOV from which MR data is to be acquired."

Riederer addresses a number of key technical developments in MRI for the year 2000. Among these is the significance of FOV selection in k-space for determining the speed of image acquisition (i.e. smaller FOV correlates to faster

image acquisition and vice versa) and spacing between k-space views or lines or strips (e.g. k-space discontinuity between adjacent views; see middle column on page 36 and figs. 1(a) – 1(c)) for fast MRI scan methods where grabbing data as quickly as possible is essential. The number of elliptic centric (radially increasing) regions chosen in k-space vary in direct proportion to the FOV.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have included “the step of determining the number of partitions based on an FOV from which MR data is to be acquired” of Riederer in the method of Ookawa in view of Laub further in view of Jezzard in order to obtain “greater image acquisition speed.”

In Reference to Claim 8

Ookawa in view of Laub further in view of Jezzard and in view of Laub further in view of Jezzard and further in view of Riederer has been shown to teach all of the limitations of claim 7. Additionally, Riederer has also been shown to present a rationale for optimizing the spacing between consecutive k-space views according to claim 8 (see the “New Acquisition Strategies” section on pages 35 and 36 and figs. 1(a) – 1(c)).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have included “the step of determining the number of partitions to minimize k-space discontinuity between adjacent k-space views” of Riederer in the method of Ookawa in order to optimize the FOV requirements for

“greater image acquisition speed” with the k-space view spacing so as to reduce artifacts and improve image quality in the reconstructed image as taught by Riederer.

10. Claims 11-14,16 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Pat. No. 5,873,825 to Misretta (Misretta) in view of Pub. No. US 2001/0004211 to Ookawa (Ookawa) further in view of Jezzard, Peter “Physical Basis of Spatial Distortions in Magnetic Resonance Images.” in: Bankman, Isaac N., Handbook of Medical Imaging Processing and Analysis (San Diego, Academic Press, 2000), pp. 425-435; hereinafter Jezzard (Jezzard)..

In Reference to Claim 11

Claim 11 States: An MRI apparatus comprising (see figure 1) : a magnetic resonance imaging (MRI) system having a gradient coils positioned about a bore of a impress a polarizing magnetic field (see figure 1, reference marks 127, 139 and 141) and an RF transceiver system (figure 1, reference mark 150) and an RF switch (figure 1, reference mark 154) controlled by a pulse module (figure 1, reference mark 121) to transmit RF signals to an RF coil assembly (figure 1, reference mark 152) to acquire MR images; and a computer (figure 1, reference mark 107) programmed to: partition k-space into a number of partitions, each having an increased distance from a center of k-space (see column 4, lines 40-67, column 5, lines 1-2 and columns 6, lines 42-67 through column 8, line 1);

apply magnetic preparation pulses at a first rate during data acquisition for a first radial partition; and apply magnetic preparation pulses at a second rate, different from the first rate, during data acquisition for a second partition.

Therefore, Misretta teaches all of the apparatus elements of claim 11 (see figure 1) with the exceptions of the steps to “play out a dummy acquisition following each of the magnetic preparation pulses” and “apply magnetic preparation pulses at a first rate during data acquisition for a first radial partition; and apply magnetic preparation pulses at a second rate, different from the first rate, during data acquisition for a second partition.”

Ookawa has been shown to teach the application of magnetic preparation pulses in k-space according to region in which you are located (see section [0033] on page 3).

Also, Jezard has been shown to teach playing out a dummy acquisition following each of the magnetic preparation pulses (**see rejection for claim 1**).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have included the step of applying “magnetic preparation pulses at a first rate during data acquisition for a first radial partition; and apply

magnetic preparation pulses at a second rate, different from the first rate, during data acquisition for a second partition” of Ookawa to the MRI apparatus of Misretta in order to produce an MRI system that allows for the combination of variable rate magnetization preparation pulse sampling of multiple regions in order to control image contrast and output of artifacts as taught by Ookawa. It would be further obvious to include the step of applying dummy acquisitions after each magnetization preparation pulse of Jezzard in the method of Misretta in view of Ookawa in order to allow spins to have reached a steady state when the image signal is detected and to reduce image noise as taught by Jezzard (**see claim 1 rejection**).

In Reference to Claim 12

Claim 12 States: “The MRI apparatus of claim 11 wherein the first rate and second rate are a function of partition distance from the center of k-space.”

Misretta in view of Ookawa further in view of Jezzard has been shown to teach all of the limitations of claim 12 with respect to claim 11. In addition, Ookawa further teaches the step “wherein the first rate and second rate are a function of partition distance from the center of k-space” (see section [0033] on page 3).

Therefore, Misretta in view of Ookawa further in view of Jezzard teaches all claim 12 limitations.

In Reference to Claim 13

Claim 13 States: “The MRI apparatus of claim 11 wherein the first rate is **greater** than the second rate if the first radial partition is closer to the center of k-space than the second radial partition.”

Misretta in view of Ookawa has been shown to teach all of the limitations claim 11. In addition, Ookawa further teaches the step “wherein the first rate is **greater** than the second rate if the first radial partition is closer to the center of k-space than the second radial partition” (see section [0033] on page 3).

Therefore, Misretta in view of Ookawa further in view of Jezard teaches all claim 13 limitations.

In Reference to Claim 14

Claim 14 States: “The MRI apparatus of claim 13 wherein the saturation pulse is a magnetization preparation pulse.”

Misretta in view of Ookawa further in view of Jezard has been shown to teach all of the limitations claim 13. In addition, Ookawa further teaches the step “wherein the saturation pulse is a magnetization preparation pulse” (see section [0022] on page 2).

Therefore, Misretta in view of Ookawa further in view of Jezard teaches all claim 14 limitations.

In Reference to Claim 16

Claim 16 States: “The MRI apparatus of claim 11 wherein the saturation pulses include at least one of a fat saturation pulse, an IR pulse, and a spatial saturation RF pulse.”

Misretta in view of Ookawa further in view of Jezard has been shown to teach all of the limitations of claim 11. In addition, Ookawa further teaches the step of “wherein the magnetic preparation pulses include at least one of a fat saturation pulse, an IR pulse, and a spatial saturation RF pulse” (see section [0021] on page 2).

Therefore, Misretta in view of Ookawa further in view of Jezard teaches all claim 16 limitations.

In Reference to Claim 18

Claim 18 States: “The MRI apparatus of claim 11 wherein the computer is programmed to carry out an elliptical centric phase order acquisition of MR data from at least one of a heart region and an abdominal region of a patient.”

Misretta in view of Ookawa further in view of Jezard has been shown to teach all of the limitations of claim 11. In addition, Misretta further teaches using a

computer program within an MRI system to carry out “elliptical centric phase order acquisition of MR data” from different regions or tissues within the body; particularly those associated with the cardiovascular system (see column 1, lines 14-23, column 3, lines 60-67 and column 6, lines 42-50).

Therefore, Misretta in view of Ookawa further in view of Jezzard teaches all limitations of claim 18.

11. Claims 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over US Pat. No. 5,873,825 to Misretta (Misretta) in view of Pub. No. US 2001/0004211 to Ookawa (Ookawa) further in view of Jezzard, Peter “Physical Basis of Spatial Distortions in Magnetic Resonance Images.” in: Bankman, Isaac N., Handbook of Medical Imaging Processing and Analysis (San Diego, Academic Press, 2000), pp. 425-435; hereinafter Jezzard (Jezzard), and further in view of Stephen J. Riederer (Riederer), “Current Technical Development in Magnetic Resonance Imaging”, IEEE Engineering in Medicine and Biology Magazine, September/October 2000.

In Reference to Claim 17

Claim 17 States: “The MRI apparatus of claim 11 wherein the computer is further programmed to determine dimensions of an FOV and, from the dimensions, determine a number of radial partitions such that discontinuities between adjacent k-space locations are reduced.”

Misretta in view of Ookawa further in view of Jezzard has been shown to teach

all of the limitations of claim 11. However, Misretta in view of Ookawa further in view of Jezzard fails to explicitly teach the step “wherein the computer is further programmed to determine dimensions of an FOV and, from the dimensions, determine a number of radial partitions such that discontinuities between adjacent k-space locations are reduced.”

Riederer teaches utilizing fast scan/imaging techniques that employ FOV calculation and compensation methods, which in turn have a direct bearing on k-space discontinuities (see figs. 1a – 1c) and middle paragraph on page 36.

Therefore, it would also have been obvious to one of ordinary skill in the art at the time of the invention to have included the step “wherein the computer is further programmed to determine dimensions of an FOV and, from the dimensions, determine a number of radial partitions such that discontinuities between adjacent k-space locations are reduced” of Riederer in the elliptic centric phase order acquisition MR apparatus/system of Misretta in view of Ookawa further in view of Jezzard in order to determine the spacing between k-space views (radial partitions) required for each k-space acquisition as taught by Riederer.

12. Claim 19, is rejected under 35 U.S.C. 103(a) as being unpatentable over US Pat. No. 5,873,825 to Misretta (Misretta) in view of Pub. No. US 2001/0004211 to Ookawa

(Ookawa) further in view of Jezzard, Peter “Physical Basis of Spatial Distortions in Magnetic Resonance Images.” in: Bankman, Isaac N., Handbook of Medical Imaging Processing and Analysis (San Diego, Academic Press, 2000), pp. 425-435; hereinafter Jezzard (Jezzard), and further in view of US Pat. No. 6,380,740 to Laub (Laub).

In Reference to Claim 19

Claim 19 States: “The MRI apparatus of claim 11 wherein the computer is programmed to partition k-space into partitions of similar size.”

Misretta in view of Ookawa further in view of Jezzard has been shown to teach all of the limitations of claim 11. However, Misretta in view of Ookawa further in view of Jezzard fails to explicitly teach the step “wherein the computer is programmed to partition k-space into partitions of similar size.”

Laub teaches the partitioning of k-space into partitions of similar size (see Laub column 7, lines 7-26). Laub further teaches that the selection of the number and relative size of the segments may be varied and customized to the application at hand so as to enable sufficient spatial and temporal resolution for tracking dynamic (fast) events within the body (see Laub, column 7, lines 13-21).

Therefore, it would also have been obvious to one of ordinary skill in the art at the time of the invention to have included the step “wherein the computer is programmed to partition k-space into partitions of similar size” of Laub in the

magnetization preparation scheme and MRI system of Misretta in view of Ookawa further in view of Jezzard in order to be able to obtain adequate and rapid spatial and temporal resolution for acquiring images using a rapid scanning technique.

Conclusion

13. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Salieu M. Abraham whose telephone number is (571) 270-1990. The examiner can normally be reached on Monday through Thursday 9:30 am - 7:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian Casler can be reached on (571) 272-4956. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

5/5/08 SA

/Brian L Casler/
Supervisory Patent Examiner, Art
Unit 3737

